

AUDIT II

Country Report

FINLAND

Heikki Väisänen
Erja Reinikainen
Final Report 07.05.2002

SUMMARY OF ENERGY AUDITING

Energy auditing has been one of the main tools in Finland's energy conservation activities since 1992. Today the new Energy Conservation Programme 2000 mentions energy audits as well as the Government's Report to Finnish Parliament on Climate Strategy, 27th March 2001.

Energy Audit Programmes

In Finland there is one Energy Audit Programme, the EAP. The EAP is run by Motiva Oy (the Operating Agent), a state owned company, the MTI's Energy Department is the Administrator, responsible for all official decisions. Consulting companies form the major part of the energy auditors and the clients are industry, service and energy sectors.

There are several energy audit models for different buildings, starting from simple service sector buildings and ranging to process industry and power production.

Finland's Energy Audit Programme (the EAP) is one of the oldest energy efficiency grant schemes in place. It is a full-scale programme, with all elements included, e.g. programme administration, detailed guidelines, auditor training and authorisation as well as a monitoring system and promotion activities.

Within the frame of the EAP the energy audits are subsidised by 40 to 50 %. The total subsidy on energy audits by the MTI during period 1992-2000 has been 11,8 MEUR.

Cumulative savings during period 1992-2000 are approx. 170 MEUR. In energy consumption the annual savings are approx. 1 TWh and the cumulative savings 4,3 TWh.

At the end of year 2000 some 3 700 energy audits had been completed and reported.

Other Programmes with Energy Audits

The Voluntary Agreement Scheme

The aim of the Voluntary Agreement Scheme is to reduce the specific energy consumption and to develop and introduce methods, which would allow energy efficiency to be integrated into everyday operations. Crucial measures according to the agreement are energy auditing and the implementation of the found energy saving measures.

The Voluntary Agreement Scheme, launched in 1997, has been a significant implementing instrument also for energy audits. The coverage of this programme level activity is extremely high, e.g. some 85 % of the total industrial energy use and over 50 % of the building stock of the service sector is within the VA Scheme. All enterprises and organisations within the VA Scheme have an obligation to implement energy audits. Therefore the set goal for the EAP, which is to have 80 % of industrial energy use and of the service sector building stock audited by the end of year 2010, should be met.

The target sectors of the Voluntary Agreement Scheme are in principle all energy users and suppliers. By the end of year 2001 the MTI had agreements with the following sectors:

- Industry
- Municipalities
- Real estate & construction
- Power generation
- Electricity transmission and distribution
- District heating
- Transport/trucking
- Transport/busses
- Oil sector

The administration of the VA Scheme has been divided between the MTI, Motiva and the branch associations. In each agreement the responsibilities have been divided in a different way, but in practice Motiva is the Operating Agent for the scheme and is responsible for the total monitoring and reporting to the MTI.

The Condition Assessment Scheme

The Condition Assessment is one part of a wider scheme, which aims at improving the condition and maintenance of residential sector buildings. The aim of the programme is to promote systematic renovation, based on a long-term plan on maintenance and repairs, and to prepare the building owners for future investments.

The Ministry of the Environment has supported condition assessments in residential sector buildings since 1993. By the end of year 1995 the condition assessment programme had covered some 5000 to 5 500 buildings, mainly block of flats. During period of 1996-2000 the number of buildings covered by the programme was 4 712 and the total subsidy 4,22 MEUR.

The Administrator of the Condition Assessment Programme is the Finnish Housing Board, which is part of Finland's Environmental Administration. Local municipal housing authorities act as Operating Agents and are responsible for handling the subsidy applications and payments as well as for the quality of the assessment work.

The target groups of the Condition Assessment are block-of-flats and terrace houses

Other Activities including Energy Audits

Environmental Management Systems

The Environmental Management Systems (EMS) have continuously been an area of "other activities", where Motiva has made efforts to influence the decision makers to adapt good practises on energy issues – in practise to adapt energy audits.

Condition assessments in the tertiary sector

The condition assessments in the tertiary sector are very popular among the Finnish building owners. In order to benefit from the interest of building owners on condition assessments the MTI and Motiva co-operated with the Ministry of the Environment to develop *The Guidelines for Condition Assessment in Tertiary Buildings*, which contains information on how to combine an energy audit and a condition assessment.

Air Audit

The Air Audit is a system-specific energy audit for compressed air systems. By the end of year 2001 over 450 Air Audits had been carried out in Finland and approx. 200 in other countries, mainly in UK, USA, Sweden and Norway.

The target groups for the Air Audit are in principle all industrial facilities, with compressed air systems. The average saving potential has been 15 to 20%.

The operating agent for the Air Audit is Sarlin Hydor in the Nordic countries and CompAir world-wide.

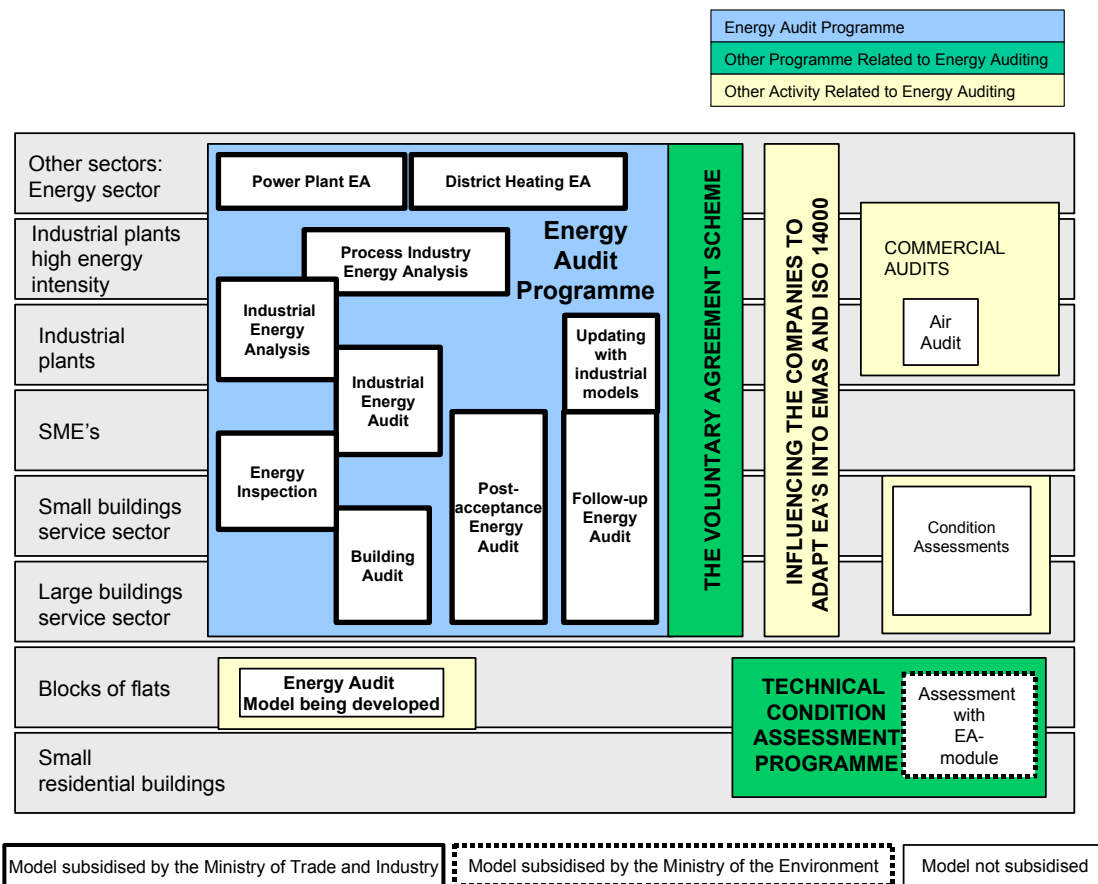


Figure 1. The Map of energy audits in Finland

Information available on the programme properties

	Finland's Energy Audit Programme	Voluntary Agreement Scheme	Condition Assessment Scheme
Status	1993-	1996-	1997-
Administration	Ministry of Trade and Industry	Ministry of Trade and Industry	Ministry of the Environment
EA models	+++		
Auditors' tools	+++		
Training, authorisation	+++		++
Quality control	+++		
Monitoring	+++	+++	++
Volumes, results	+++	+++	++
Evaluation	+++	+++	

+++ = Detailed information available
 ++ = Some information available
 + = Very little information available
 = No information available / does not exist

General information

Organisation Motiva Oy
Contact person Mr. Heikki Väisänen
Phone +358 9 8565 3100
Email heikki.vaisanen@motiva.fi
Address Urho Kekkosen katu 4-6 A
00100 Helsinki, Finland
www www.motiva.fi

Finland's EAP

Organisation Motiva Oy
Contact person Mr. Janne Hietaniemi
Phone +358 9 8565 3100
Email janne.hietaniemi@motiva.fi
Address Urho Kekkosen katu 4-6 A
00100 Helsinki, Finland
www www.motiva.fi

Finland's Voluntary Agreement Scheme

Organisation Motiva Oy
Contact person Ms. Ulla Suomi
Phone +358 9 8565 3100
Email ulla.suomi@motiva.fi
Address Urho Kekkosen katu 4-6 A
00100 Helsinki, Finland
www www.motiva.fi

Air Audit

Organisation Sarlin Hydor
www www.sarlin.com

Condition Assessment Scheme

Organisation: Ministry of the Environment
www www.vyh.fi

THE COUNTRY REPORT

1. Background and Present National Energy Policy

1.1 Previous activities

The history of energy auditing in Finland can be tracked back at least to the beginning of the 80's when the MTI launched the first energy auditing campaign. One aim of the campaign was to develop standard procedures for energy auditing but the campaign was ended without expected effect of continuity among the building owners.

During period 1984-87 energy auditing volume varied annually depending on the taken subsidy policy, the marketing activities of the auditors and to some extent on the building owner's interest. By the end of year 1987 the market for energy audits had collapsed totally due to two reasons: the start-up of an overall economical overheating, specifically affecting the building sector and a simultaneous rapid fall in energy prices.

In January 1992 the market for energy audits opened again. The customers were ready and interested to reduce their energy costs because the rapidly weakened economical situation in Finland. A significant driver was the MTI's decision to start subsidising energy audits by 50%.

Finland's Energy Audit Programme (EAP) started with a relatively low profile. During the first year the EAP actually did not have that kind of properties that it would today be considered to be a programme level operation. Most of the auditing done during the first year, was by a few consulting companies. The EAP gained very little publicity in the beginning, but the MTI had a vision, based on in-house experiences on energy auditing, and launched two major development projects.

The first development project in 1992 was aimed to monitor the kick-off phase and from that experience, to further develop the operation. The project produced ideas on e.g. programme administration and on other basics of a programme level operation.

The second development project in 1993 produced the first detailed guidelines and standard auditing procedures. Also auditors' toolbox software and training programme for the auditors were developed. The MOTICOP monitoring system was built and taken into use during the spring of 1994. These programme level properties were developed mainly during 1993 and by the summer of 1994 the activity, which started as a subsidy policy had become a full-scale energy audit programme.

1.2 Present national energy policy

In Finland the responsibility for energy efficiency of buildings and processes is divided between four ministries. The Ministry of Trade and Industry (MTI) has an overall responsibility and a specific responsibility for actions in the industrial and the tertiary sectors, which represent the major share of the total energy consumption in Finland. The Ministry of the Environment (ME) is responsible for the residential sector, the Ministry of Transport and Communications is responsible for the transport sector and the Ministry of Agriculture and Forestry is responsible for the farms.

The Finnish Energy Strategy, approved by the Parliament in the autumn of 1997, stated that the objective of the energy policy is, by utilising economic means of steering and market mechanisms, to create circumstances that support both economic and employment policies. These circumstances should ensure the availability of energy, keep the price of energy competitive, and enable Finland to meet her international commitments with respect to emissions into the environment. In particular, the energy strategy measures are focused on the following fields of action:

- Development of the structure of energy production in a direction that involves reduced emissions of carbon compounds
- Promotion of the energy market
- Promotion of the efficient use of energy and energy conservation
- Promotion of the use of bio energy and other sources of indigenous energy
- Maintaining the high standard of energy technology
- Ensuring a sufficiently diversified and advantageous energy procurement capacity and
- Ensuring the secure supply of energy

Finland's Energy Conservation Programme, which was completed in 2000, is the framework for promoting efficient energy consumption and energy savings. Financing energy audits is mentioned as one way of implementing the Programme. Implementing the Energy Conservation Programme itself, is part of the realisation of Finland's National Climate Strategy. In the Government's report to the Finnish Parliament, 27th March 2001, energy audits are mentioned as one measure required by the Climate Strategy by following words:

- The level of the energy audits and analyses of industry and the service sector will be maintained by means of continuous follow-up, quality assurance and training
- Upon completion of a new building or during the guarantee period, energy audits of commissioning concerning the energy efficiency of buildings will be adopted either by contractor or by drawing up provisions for building regulations
- Energy audit models, which can be included in condition assessments, will be developed for residential block-of-flats and terraced houses and for single-family houses. Residential buildings and their heating systems will be brought under systematic energy audit activities and they will be made eligible for aid as part of the energy conservation agreement scheme. Activities will be developed further, and quality assurance and follow-up will be continued
- Energy certificates of buildings based on energy audit data or energy need calculations that are required by the building regulations, will be taken into use. The preparations for the legislative amendments required by the introduction of the certificates will be started

The present national policy points out clearly that energy audits are one important element both in Finland's Energy Conservation Programme and in Finland's Climate Strategy.

1.3 Motiva Oy and its tasks

The Operating Agent for the EAP is Motiva Oy. Motiva Oy (formerly the Information Centre for Energy Efficiency MOTIVA) was established in May 1993 by the MTI to implement the ECP-92. Since December 2000 Motiva has operated as a state owned company. Motiva has been responsible for the development of the EA-models, training and authorisation of the auditors as well as maintaining monitoring and supportive marketing activities since it's establishment.

Motiva's areas of activity, in addition to development, promotion and monitoring of energy auditing in Finland, include influencing attitudes toward rational energy use and energy saving, promotion the use of renewable energy sources and the implementation of energy efficient technologies. Motiva actively co-operates with consumers of energy, companies providing services and products related to energy, communities, energy suppliers, and authorities involved in the field of energy.

2. Energy Audit Programmes

2.1 Finland's Energy Audit Programme (the EAP)

2.1.1 Goals

When the Ministry of Trade and Industry (the MTI) started granting subsidies on energy audits in 1992, the government had set targets on improvements on energy efficiency as a part of Finland's Energy Conservation Programme (ECP-92). Explicitly the first goal on energy auditing volumes was set in 1993. The goal was to have some 80 % of the building stock of the tertiary and industrial sectors audited by the end of year 2005. In order to achieve this goal, Motiva estimated that the annual auditing volume must be increased to 70 million m³ within the following three years and maintained until the target year 2005. The goal for energy auditing was not an official target set by the government, but one starting point for the development of Finland's Energy Audit Programme.

Year 1994 with a total auditing volume of 34 million m³ was in line with the set goal. However, the first half of year 1995 had already revealed signs of unfavourable changes in the market place. In the autumn of 1995 a Working Group, established by the MTI, studied the possibilities to secure the continuity of energy auditing. The Working Group set a new goal, which kept the coverage of 80 % in force, but set the target year to 2010, which was in line with Finland's renewed Energy Conservation Programme (ECP-95). Motiva estimated that in order to meet this goal, the annual auditing volumes must be increased to 50 million m³ by the end of year 1997.

Years 1995-1997 showed that really strong implementing instruments are needed before the market place can be influenced effectively. A voluntary agreement scheme was already then pointed out as one of the only options, which could provide the desired effect. Although the goals set for the energy auditing volumes have been a bit too ambitious in relation to available resources and means, the goal setting itself has been quite essential.

When Finland's Voluntary Agreement Scheme was finally launched in November 1997, more effort was put into marketing of the agreements than marketing of individual energy audits. During the period 1997 – 1999 the EAP was running normally and the development in auditing volumes were monitored but marketing was considered as a parallel or a secondary effect of the successful marketing the VAs. In 1999 municipalities and firms within the VA Scheme represented already over 90 % of the total auditing volume.

In the year 2000 goals for energy auditing volumes were set again. In the tertiary sector the goal was an increase of 30 % in building volume compared to year 1999. In industry the goal was to maintain the level of energy usage of the previous year. Both goals were achieved. For year 2001 the goal for tertiary sector was again an increase by 20 % and in industry, to maintain the level of year 2000, measured in granted subsidies. Also this year both goals were achieved.

The target setting for industry has become more complicated since 1998 when the energy intensive process industry entered the EAP. Compared to previous years 1992-1997, when the industrial audit clients were mainly SMEs, the increase in energy usage within the EAP has been enormous.

For the last two years the energy audit volumes in industry have been approximately at a level which the present auditor capacity can handle, but also the overall target is being reasonably well met. In the tertiary sector some increase is still needed.

The energy sector entered the energy audit program in 1998 but without specific goals from the EAP's point of view. The goals for these sectors have been given within the VA Scheme and the EAP has more like a supportive role.

2.1.2 Target sectors

The MTI's Energy Auditing Programme was originally targeted to tertiary and industrial sector buildings and processes, not excluding any building types or sub-sectors. The energy intensive process industry, although the subsidies have been available since 1992, entered the EAP in 1998. Due to the VA Scheme, subsidies have been available also for energy audits in power plants as well as for district heating plants and networks since 1998.

The residential sector has been excluded totally, but due to a new sector agreement for apartment buildings, which is planned to be put into force in 2002, energy auditing will be broadened to cover that sector also. Whether the residential sector programme will be run as a totally separate programme or in some way in connection with the ongoing EAP, is still an open question. Energy audits in the residential sector are under the responsibility of the Ministry of the Environment and the ongoing EAP is administrated by the MTI.

Government owned buildings are excluded from the EAP because the government does not subsidise its own administration. Government owned buildings are being audited in the frame of the Agreement on the Promotion of Energy Conservation with the MTI and the auditing methods used are mainly the Motiva Energy Audit Models.

The scope of the EAP has so far been in the energy consumed by a building or consumed in a building. Energy audits in "other sectors" as defined in this report e.g. street lighting have not been subsidised. However, if the experience from other countries bring out good results, it is possible that the scope of the EAP is broadened in the future.

2.1.3 Administration

The administration of the EAP is divided between three organisations. The Energy Department of the MTI is the main responsible body. Most of the administrative routines have been delegated to 15 regional Employment and Economic Development Centres (EEDC) and the responsibility for running the EAP to Motiva.

The MTI- the Administrator

MTI's Energy Department administers only large-scale energy audit projects with a total audit cost over 170.000 EUR and some non-standard projects of pilot nature. The Energy Department confirms annually a limit for the budgeted total subsidies, which has typically been 1,5...2,0 million EUR per year. The Energy Department is the official body to put into force guidelines etc. administrative procedures concerning the EAP, although the development work is in practise carried out by Motiva.

Motiva – the Operating Agent

Motiva is responsible for the overall co-ordination and monitoring of the EAP as well as quality control of the audit reports, training and authorisation of the energy auditors and promotion of energy auditing in general. Motiva is also responsible for all development projects and the official guidelines for the EAP, officially put into force by the MTI, but planned and written by Motiva. Motiva's Energy Audit Team consists of five persons from Motiva's staff and one consultant, who together use annually approx. 2 man-years to run the EAP. The following "titles" are not official nor based on Motiva's organisation chart, but just to illustrate the functions and responsibilities between the Energy Audit Team members.

- Team Leader: quality control for industrial energy audits, development projects, presentations
- Senior Expert: guidelines of the EAP, development projects, international projects, presentations
- Senior Expert (Consultant): training of energy auditors, quality control for tertiary sector energy audits, international projects
- Information Services Expert: production of all promotion material, development of promotion campaigns and activities
- Data Management Expert: overall responsibility for the monitoring system, data analysis and the Annual Report on Energy Auditing
- Data Management Assistant: input of the monitoring data, data analysis.

In addition to the permanent staff, so called Auditor Circle was formed from the six most experienced senior energy auditors in January 2000. The Auditor Circle is a back-up team for Motiva's Energy Audit Team and has been used in development projects and as an advisory group whenever quick comments on e.g. new guidelines are needed.

The EEDCs

The EEDCs have been responsible for handling the applications and payments of the subsidies since September 1994. The persons in the EEDCs are handling the applications and payments as one of their daily routines. The share of their total working time spent on EAs is quite marginal. Motiva's role is to assist the EEDCs in specific questions.

Two changes have taken place in the administration of the energy audits. During period January 1992 - April 1993 the handling of applications and payments was carried out by MTI's Energy Department alone and during period May 1993 - August 1994 in co-operation with Motiva. When Motiva was established in May 1993, all other work concerning energy audits except the formal and official decision on a subsidy was transferred to Motiva. Involving the EEDCs in the EAP in 1994 was a part of a larger process where several responsibilities were delegated from the Energy Department to local offices.

The administration of the EAP has been quite light but still - operational. In comparison to many other grant schemes the subsidies on energy audits have been easy to administrate – which was one of the main ideas when the administration for the EAP was planned. The area that has needed special attention is the exchange of information between the EEDCs and Motiva. Energy audits represent such a small share of the EEDCs' work, that it is difficult, if even needed, to have expertise developed in this specific area. To be able to monitor the programme the follow-up system must have real-time data and therefore it is crucial that the EEDCs submit continuously information on all subsidy applications and completed energy audit reports.

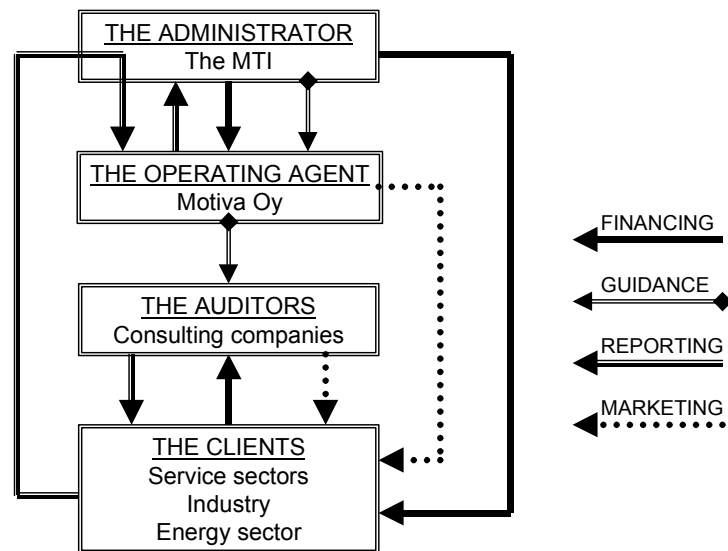


Figure 2 The Key Players and the administration of Finland's EAP

2.1.4 Implementing Instruments

Energy auditing has always been totally voluntary but subsidies have been used as an implementing instrument. Quite a lot of effort has been put to the promotion of energy auditing since 1992 when the MTI started the grant scheme. In comparison to the majority of other grant schemes, the EAP is one of, if not the oldest in place. The implementing instruments of the totally voluntary activity can be listed as following:

- Subsidies available for energy audits
- Supported by a comprehensive EA program
- Active promotion by the Operating Agent
- Connected to Finland's Voluntary Agreement Scheme – a very strong driver providing subsidies also for the investments proposed in energy audit reports

Finland's Voluntary Agreement Scheme, *the Co-operative Agreement on the Promotion of Energy Conservation* is administrated by the MTI and the first agreements were signed in November 1997. By the end of August 2001 the coverage by the agreements was nearly as wide as the overall goal for the EAP – energy auditing 80 % of the building stock of the tertiary and industrial sectors. All enterprises and organisations entering the VA Scheme are obligated to implement energy audits in their premises. The VA Scheme was a significant breakthrough for energy auditing because it practically removed all obstacles from the market place – making the energy audits in practice voluntarily mandatory.

The subsidy for energy audits has varied between 40 and 50 %. From the beginning of the EAP until April 1995 the subsidy was 50 % but in May 1995 the subsidy was decreased to 40 %. The reduction was one result of the budget cuts by the government due to the difficult economical situation in Finland. In order to promote the VA Scheme, the MTI has been granting 50 % subsidies since January 1998 to those industrial enterprises and municipalities, which have signed the agreement with the MTI. In addition to the higher subsidy for energy audits, there is also a max. 10 % subsidy for energy saving investments if the measure is presented in an energy audit report.

One lesson learned, based on the energy audit volumes during year 1995, was that the market reacts quite strongly to rapid changes in the subsidy policy. The reduction in the subsidies for audits and termination of the subsidies (max 30%) on energy saving investments at the same time in the spring of 1995 had an effect on the auditing volumes. The autumn season had normally been more active than the spring, but during that year the situation was just the opposite.

In the past there were several discussions on the subsidy policy, whether the audits should be subsidised or not because the audits are quite profitable to the clients. These discussions ended when the auditing volumes took a three-year dive. Since 1997, when the VA Scheme was launched, the subsidies have been one part of the agreement – a commitment from the MTI's side at least until year 2005, when the last of the present agreement expire.

Mandatory / legal schemes	Voluntary schemes
Energy audits are not linked to mandatory schemes.	Audits are integrated part to fulfil the requirements of voluntary agreements.
Fiscal incentives (taxes)	Fiscal incentives (subsidies)
No link with the tax system .	Subsidies for energy audits granted by the Ministry of Trade and Industry.
Marketing oriented schemes	Policy issues
No special promotional instruments.	Energy audits are mentioned in the Finnish Energy Conservation Programme and Finland's National Climate Strategy.

2.1.5 Energy Audit Models

The EA-models used in Finland are divided in two categories: The Motiva Energy Audits are EA-models, which are used in tertiary and in industrial sectors. The other category is Energy Sector Models. EA-models of both categories are subsidised by the MTI. The main difference is in the monitoring and quality control. Due to the VA Scheme the subsidies have been available also for the energy sector since 1998, but for those audits there is no quality control or monitoring system in place and therefore Motiva's guidance does not concern energy auditing in the energy sector.

The official Motiva Energy Audit Models are:

- *Energy Inspection*: A model for very small buildings in the tertiary and industrial sectors
- *Building Energy Audit*: The basic model for tertiary buildings
- *Industrial Energy Audit*: The lighter model for facilities with low energy intensive core processes or facilities where the saving potential of the process is known to be marginal
- *Industrial Energy Analysis*: The heavier model for facilities with medium energy intensive core processes or facilities where the saving potential of the process is known to exist
- *Process Industry Energy Analysis*: A two-step EA-model for energy intensive process industry, where the first step is a scanning phase and the second step consist of one or more above mentioned *Industrial Energy Audits* or *Analyses*
- *Post-acceptance Energy Audit* (PEA): A model for new and renovated tertiary buildings. The model is specially designed to set the energy consumption into an optimal level after the building has been taken into use.
- *Follow-up Energy Audit* (FEA): A model to up-date previous energy audits. The model is suitable for the tertiary sector, but in industry where the "follow-up auditing" is also possible, the basic industrial models are used instead

The Energy Sector Models are:

- *District Heating Energy Audit*: A model for heating plants and distribution network
- *Power Plant Energy Analysis*: A model for power plants

The level of guidance for the abovementioned EA-models varies. In general the reporting of all models must follow the grouping shown in figure 3. All models have a Model Table of Content and most of the EA-models have separate model specific instructions on how to carry out the audit work and a Best Practice Report.

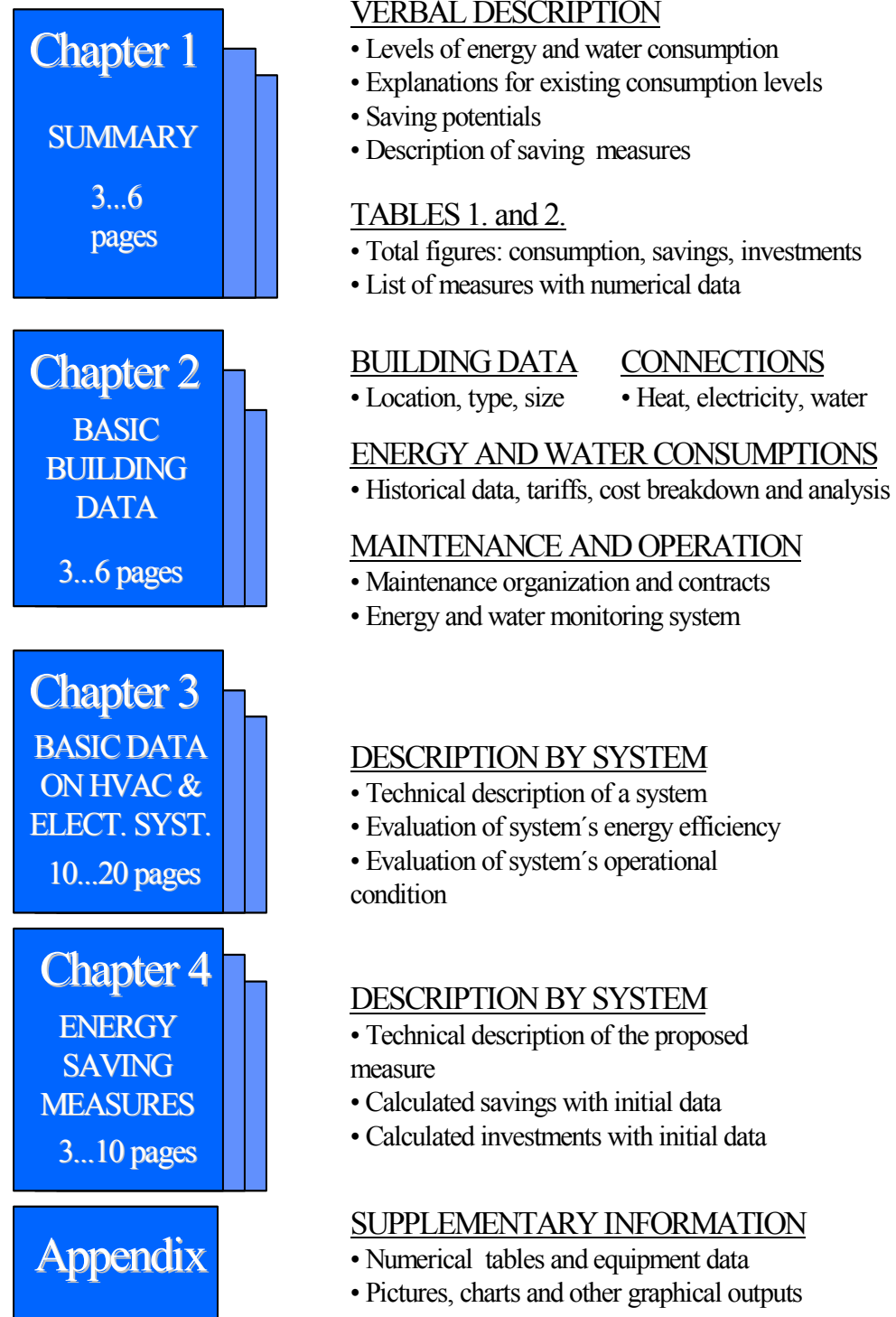


Figure 3. The basic structure of an energy audit report

Finland's EA-model development process

The development of new EA-models in Finland has always been a result of feedback received from the field or incongruous reporting procedures – a typical feedback from quality control. The length of a development phase of a new EA-model has been approx. one year. Every new EA-model has been tested in several pilot-projects before

it has been published and put into force. Once a new EA-model is released, the first submitted reports have been evaluated to ensure that the requirements are met. Even the most experienced auditors may have difficulties adapting a new approach. The general EA-model development process is illustrated in figure 4.

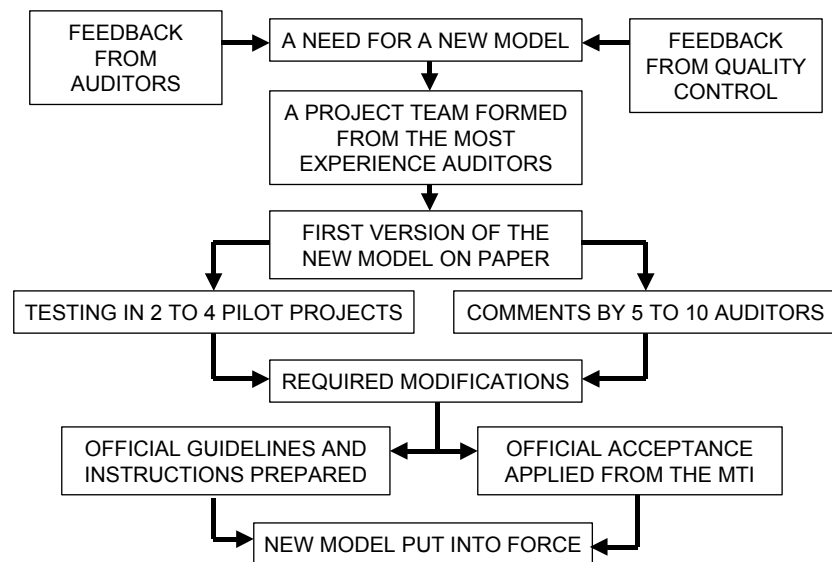


Figure 4 Finland's EA-model development process

History of Finland's EA-model development

The development of the EA-models has been a long process. When the MTI started supporting energy audits in 1992 the energy audits were carried out and reported according to quite general guidelines. In May 1993 one of the tasks, given to Motiva by the MTI, was to develop of standard energy auditing procedure and in December 1993 the first Motiva Energy Audit Model was published. The auditors were guided by the following documentation:

- A Model for the Table of Contents
- An Example for an Energy Audit Report
- Guidelines specifying the content of work and requirements for reporting the energy audits

During year 1994 when a large group of industrial energy audit reports were reviewed in Motiva, it became clear that the auditors have three different approaches. The lightest industrial energy audit reports covered only the building service systems and the building envelope. The second level of audits covered also the process service systems but more or less ignored the process. The third level of audits covered also the process. It became quite clear that the lightest scope of work provided rather small savings and, compared to the other levels, probably neglected viable energy saving measures.

The second and third audit-levels could be justified. If the consumption of the process is small compared to the total consumption or the nature of the consumption (e.g. water consumption in a brewery) refers to marginal saving possibilities in the process, there is no point spending time on studying the process. But if the process consumes a major share of total consumption or the nature of the process refers to good savings, the process must be included.

In 1995 Motiva put into force new guidelines with three Motiva Energy Audit Models: one EA-model for the tertiary buildings and two EA-models for the industrial sector. The industrial EA-models were named as *the Industrial Energy Audit* and *the Industrial Energy Analysis*. The scope of the analysis-level covers the process and the audit-level takes into account only the external energy flows and amounts but treats the process itself as a black box. The service sector EA-model was named *the Building Energy Audit* (model updated in 1999). In 1995 it was also necessary to give names to different EA-models. The term "Motiva Energy Audit" became more like a common definition covering all EA-models.

The market adapted these EA-models rather well. Several experienced auditors commented that the published EA-models fulfil the needs of their clients well. Introducing several EA-models into the market place revealed also some risks. Because the analysis-level provides a 20...30 % higher fee for the work, there have been some cases where the auditor has sold the client an analysis-level of work but implemented only the audit-level. In most cases the client is not capable of evaluating the auditor's work in detail. Therefore the responsibility that the guidelines are followed lies on Motiva.

The next feedback from the field concerned the problem with small buildings. The reporting requirements of the existing Motiva EA Models were too heavy. The allowed cost of an audit was based on building volume or annual energy and water costs and in small buildings this provided too low budgets. In May 1998 Motiva put into force new guidelines with the fourth Motiva EA Model, *the Energy Inspection*.

The Energy Inspection can be used in tertiary sector buildings with a building volume less than 10.000 m³ and in industrial sector buildings with an annual energy and water cost less than 250.000 FIM (42.000 EUR). *The Energy Inspection* is normally carried out by two auditors. One day spent on site and another day to write the report. *The Energy Inspection*, compared to other Motiva Energy Audit Models, is light in reporting and the fieldwork concentrates tightly on the energy saving measures alone.

The Voluntary Agreement Scheme (1997) created a need for further development as the energy intensive process industry and the energy sector entered the EAP for the first time. The third industrial model, *the Process Industry Energy Analysis*, was put into force in 1999. The first energy sector model, *The District Heating Energy Audit*, was put into force in 2001 and the second, *the Power Plant Energy Analysis*, in 2002.

With these nine EA-models the EAP covers all types of buildings of different ages in the service and industrial sectors as well as in the energy sector. The number of EA-models in Finland has reached the point where the complexity of the administration has put a limit for further development. Although all EA-models today have clearly separate targets and the development has always been started because the market place has required new EA-models, some clients have found the number of EA-models confusing. Whether this is a question of poor marketing by individual auditors or a real problem, is another question.

Lessons learned

Modelling of energy audits is not an easy task. If the guidelines are too general, the modelling has no effect and if the guidelines are too detailed there will be many cases where the model just doesn't fit. When Motiva published the first Motiva Energy Audit Model, there were quite a lot of arguments against any modelling. Many auditors would have preferred to have totally free hands to determinate their scope of work. Today, when the procedures have been widely adapted, everyone seems to be satisfied - some would even like more clearly specified EA-models put into force to make sure that all auditors put in similar tenders. Every programme developer has to decide how many EA-models are needed and how detail specification is needed.

Based on the experience on different levels of modelling and guidance, one comment can be given. If the number of auditors is small and the auditors are good and the audit targets are heterogeneous, e.g. energy audits in the process industry, the guidance should not be too detail, which in practice would also be difficult to accomplish. Detail guidance would in this case be too rigid and limit the auditors' opportunity to use their expertise in the most cost-effective way. It is also a good question whether the Operating Agent really has the knowledge to advice the best experts in details. Therefore in this case the guidance should be more general.

The other option is that the audit targets are homogenous (apartment houses) but there is a heterogeneous group of auditors working in that field. Then the guidance can and must be detail. Otherwise the results will also be very heterogeneous, which means - poor quality.

2.1.6 Auditors' Tools

MOTIWATTI 2.0 Software

The main auditor tool used in Finland is the MOTIWATTI 2.0 software, which has been developed especially for the auditors. First version of MOTIWATTI was released in December 1993. Versions 1.0 to 1.8 were based on EXCEL but in 1997 Motiva faced the fact that the software could no longer be updated – one problem with EXCEL was the continuous need for updates whenever Microsoft released something new. The old versions had also some restrictions and finally a decision was made to launch a development project. The total cost for the two-year development project of the new MOTIWATTI 2.0 has been approx. 100.000 EUR. Version 2.0, which is practice totally new program compared to the old versions, was released in the autumn 2000. The program is in principle a shareware but available only to Motiva Energy Auditors. The MOTIWATTI 2.0 CDs have been given only to auditors who participate either the MOTIWATTI 2.0 Software Course or The Motiva Energy Auditor Basic Course.

The MOTIWATTI 2.0 is a practical tool for an energy auditor. The main idea being "adequate accuracy with reasonable amount of input data". The building to be audited is modelled into the programme and then the auditor can start simulations on individual energy saving measures. Traditionally the calculations on energy saving measures, if done properly, have required a lot of time. One idea of the programme is to form a detail breakdown of the energy use. When all systems have been "created" and the theoretical consumption equals the measured consumption, the auditor can be quite sure that the saving of a considered measure is at correct level.

The programme has some restrictions, some due to irrelevant meaning in Finland, some due to unavoidable inaccuracy when the input data needs to be limited. Some notes about the restrictions.

- Is not a simulation tool for capacities or target consumption
- Does not calculate heat transfer dynamically
- Does not calculate cooling energy
- Does not handle humidification processes
- Is not suitable for special spaces e.g. glass atriums
- Does not use hourly data in calculations although takes into account the different hourly outdoor temperatures when e.g. the running hours of a ventilation unit are changed

The MOTIWATTI 2.0 has also the two standard reporting tables, which are required from the auditor as a part of the reporting. The emissions of used energy sources can be defined and in addition to energy units and costs, the programme will also calculate reductions in CO₂ for each energy saving measure.

In comparison to manual calculation or auditors' own calculation tools the MOTIWATTI 2.0 has solved the following traditional problems:

- The net effect of overlapping measures is calculated automatically
- Side effects e.g. decreasing internal electrical loads (lighting) will increase the demand for heating
- The order in a set of measures - the profitability of a measure depends on the order of implementation, e.g. reducing ventilation running hours and installing a heat recovery system – when the list of measures has been created the auditor has the freedom to change the order without new calculations
- The optimal option of the several available, the calculation must be done several times but quickly
- Different tariffs – may be complicated if the tariff varies and includes several components. The tariff itself can be a proposed measure and then it will affect to the profitability of all other measures.

The MOTIWATTI 2.0 Software requires the following user environment:

- Windows 95, 98, 2000, NT 4.0
- Min 800x600 resolution
- Memory min. 32 MB (64 MB recommended)
- Processor min. Pentium 200 MHz
- 25 MB of free disk space
- MS Excel 97 needed for outputs

Energy Auditor's Handbook

Work on Energy Auditor's Handbook was started in spring 2000 and the first version was completed by summer 2001. The idea of the handbook is to collect all instructions on how to do the auditing work into one document. Until today this kind of guidance has been given both in the official guidelines by the MTI and in the model specific instructions. When the number of different EA-models has increased it has become quite difficult to write the instructions so that there is no overlapping and that the given requirements can be understood – there are more and more model specific exceptions and notes "this does not concern model X".

The Auditor's Handbook consists of three parts. Part I (35 pages) presents the general issues e.g. an overview on Finland's EAP and energy audits in other countries, principles on writing a good EA report and how the savings and investments should be calculated. Part II (some 90 pages) contains the auditing of the mechanical and electrical systems – in practice the content of an energy audit in a tertiary sector building. Part III (some 25 pages so far) contains special systems, which are common in industrial sites e.g. compressed air system, but also some special areas e.g. swimming pool equipment, kitchen equipment, which may exist in tertiary sector buildings but need special expertise if audited properly. The aim is to expand the Part III with new specific areas as well as update the written chapters whenever there is new information available. All chapters have been written by the best national experts.

The Auditor's Handbook will be available at Motiva's web site and only in electronic format. Printed copies would create an updating problem because the vision is that the handbook is never ready but is continuously processed.

The Best Practice Reports

The Best Practice Reports can be considered as Auditor's Tools also. The Best Practice Reports are available as printed copies and in electronic form but as "read-only" versions to avoid the risk of some auditors just copying the text.

The Best Practice Reports are available on the following Motiva Energy Audit Models:

- Energy Inspection
- Building Energy Audit (the most comprehensive and visually the best of these four)
- Post-acceptance Energy Audit
- Follow-up Energy Audit

The new energy sector EA-model, Power Plant Audit, will have a Best Practice Report published in year 2002.

Data sheets

Motiva has developed two EXCEL-sheets for the auditors. One sheet is for data collection purposes, but in practice the auditors typically use very personal ways of making notes and documenting information on site. This data collection sheet was created as a part of one EA-model development process but is not a requirement or an integral part of any specified EA-model. The other sheet is part of EA-model Energy Inspection. Because Energy Inspection was meant to be light in reporting there is a table, to be included as an appendix of the report, in which all numerical information on the audited building can be presented in a condensed form. Both EXCEL-sheets are available via email from Motiva.

Every energy audit report has two mandatory tables in which the key figures must be presented. These reporting tables are automatically generated if the auditor uses the MOTIWATTI software but the tables (EXCEL) are also available from Motiva. The monitoring procedure requires each auditor to submit a diskette along with the printed report.

2.1.7 Training of energy auditors

Auditor training today consists of the following four types of activities:

- Motiva Energy Auditor Basic Course
- Energy Auditor Extension Course
- Process Industry Auditor Seminar
- Motiwatti 2.0 Software Course

Motiva started the training of energy auditors in December 1993. During the period December 1993 - September 2001 approx. 1300 persons have attended the Motiva Energy Auditor Basic Courses. The Motiva-auditors are mainly mechanical and electrical engineers (MSc. or BS.). Although the courses have been very popular, only 150 to 200 auditors are active in the auditing business.

Motiva Auditor Extension Courses have been arranged annually since autumn 1998. These courses are more like current affairs seminars, presenting the latest news on the EAP and other topics related to it and there is no obligation for the auditors to participate.

In year 2000 it became necessary to arrange special authorisation seminars to personnel of the process industry. This personnel is mainly "energy manager" level staff, which will be responsible for the EA projects. Motiva's basic course does not give any real added value to the implementation of the *Process Industry Energy Analysis*- which model is used in this sector. Nor is there point to make the personnel from these companies to sit in a classroom for two days just to fulfil the general requirements of the guidelines - if we know in advance that 80 % of the presented material will not benefit them at all. The main idea of the Process Industry Auditor Seminar is to inform the attendants on the administrative procedures, advise them to use experts whenever their own skills or resources become limited. Also case-studies are presented to create creditability to the activity.

When the new MOTIWATTI 2.0 software was released in the autumn of 2000, Motiva arranged a regional training tour where the auditors could both see how the new version works, and acquire the program CD.

International training courses are not marketed but on a request Motiva has arranged training for experts from Greece (5 persons in 1999) and Russia (4 persons in 2000).

Motiva Energy Auditor Basic Course

The Motiva Energy Auditor Basic Course is a two-day event and concentrates on energy audit procedure, not on basic engineering skills. The first day consist on general issues and lectures are common for both mechanical and electrical auditors. The first day includes the following topics:

- Motiva Energy Audit as a process
- Guidelines for Motiva Energy Audits
- Marketing the Motiva Energy Audits
- Energy saving opportunities in HVAC systems
- Energy saving opportunities in electrical systems
- Calculating the savings and the investments
- How to prepare a good energy audit report

The second day has a separate programme for mechanical and electrical auditors, although the topics are common.

- How to carry out the field work, where to look for savings
- Building automation systems
- MOTIWATTI 2.0 auditors simulation programme

All attendants are given the MOTIWATTI 2.0 software and an exam to be done as homework. The exams are inspected at Motiva on the principle “passed” or “failed”. An authorisation is awarded by Motiva to all those who pass the exam. For those who fail in the exam a second change is given, but then there is an extra charge of 83 EUR. This extra charge was put into force in 2001 when several attendants clearly tried to pass the exam by guessing the correct answers. The amount of this charge is not the main point but it will make the attendants think twice before taking the risk of needing to ask for additional funding from their superiors – even 83 EUR totally wasted is too much to be totally wasted.

Lessons learned

When the auditor training was planned in Finland one question was the length of the training course. It is obvious that it would require a training period of several weeks with practical field work and a tight exam to be absolutely certain that all auditors have the sufficient knowledge and moreover, a test audit to ensure the readiness to carry out an energy audit in practice. If the trainees were non-engineers, the needed minimum length for training would be months if not years - taking into account how long it takes to graduate from any technical faculty.

During the first 18 months of the EAP 85 (Jan. 1992 – June 1993) some 90 % of audits were carried out by consultants. When the EAP was being planned, the situation was analysed and it became obvious that there is no point trying to find other type of organisations to start up auditing activities – a matter of choosing one of the key players for the EAP.

The two-day course is a compromise but enough to give experienced mechanical and electrical engineers a good view on how to apply their existing knowledge in the area of energy auditing. Two days is also the max. length for a course to which the consulting companies will send their employees. If a course is longer, the number of trainees will easily decrease significantly. Moreover, additional 2 or 3 days won't really improve the outcome of the course. The auditing procedures will have to be learned during the first audits in the field anyway.

The legislation has created some problems because legally Motiva cannot restrict any person's right to take the course. Therefore there are some auditors who probably do not have the adequate basic knowledge to carry out proper energy audits.

To lighten and simplify the administration process of the authorisation, due to limited resources in Motiva, a decision to have the exam done as homework was an unavoidable necessity.

Most of the choices made in Finland can be justified but the "homework" type exam has not been a good option. An authorisation once given, cannot be cancelled just because the bar has not been put high enough in the beginning. One option, which should have been considered more thoroughly in the beginning, is to arrange the exams in a controlled environment e.g. in regional Institutes of Technology, which are quite familiar arranging such events. This was seriously planned in 1999 but the idea never ripened to concrete level.

Although the training process does not guarantee that each authorised energy auditor is actually skilled enough to carry out an energy audit, the quality of audits is not jeopardised in general. The quality control is very tight and auditors doing poor work are not treated gently.

2.1.8 Authorisation of energy auditors

The authorisation of energy auditors started in January 1993. By the end of year 2000, 894 energy auditors have received the certificate to operate as a Motiva Energy Auditor. The guidelines for the EAP require that in every grant application the applicant (the client) must present the names of two authorised auditors. One authorised auditor must be a mechanical auditor (LVI-auditor) and the other an electrical auditor (S-auditor).

One exception was done in year 2000. When the process industry entered the EAP and the new EA-model, Process Industry Energy Analysis, was published, there was a need to authorise the personnel (P-auditors) of these "client organisations". This approach was partly based on a compromise – how to make the audits possible in a new and quite different target sector, but in line with the general guidelines of the ongoing EAP.

In the process industry it was clear that the client organisation would be doing significantly bigger share of the total audit work than in other Motiva Audit Models. Therefore the client organisations needed to be informed on the basics of the EAP and on the general principles of audit work. It was also necessary to clarify the fact that the MTI is not just giving the money away but expects results to be achieved - a subsidy applied for and received has some obligations, which needs to be fulfilled. This P-auditor certificate is valid and can be used instead of the LVI- and S-auditor certificates only in projects where the client's own sites are being audited.

The authorisation is personal and goes with the auditor e.g. if the auditor is employed by another company. There is not limit to the validity of the authorisation. This principle of everlasting authorisation has created some problems and possibilities to change it have already been studied.

A plan for a complete revision of the training and authorisation processes was developed in year 2000. This plan includes a three-level authorisation, where the skills of the auditor and the difficulty of the building or site to be audited have a match. The validity of the authorisation would be restricted to two years, unless the references from that period are satisfactory. Also the quality control in Motiva would be given permission to drop an auditor to a lower level if the skills are not adequate to submit good work. Each level would have a separate training course and an exam. This new system, although seriously preferred and recommended by the Operating Agent in order to improve the total quality of the EAP, is today too heavy to be administrated with Motiva's existing resources.

2.1.9 Quality Control

Motiva has been responsible for the quality control of energy audits since 1993. The taken approach, a detail and tight quality control, is a result of the light authorisation process. In principle it is relatively easy to get the authorisation but difficult to operate as an energy auditor if the quality of work is not satisfactory. The quality control process is illustrated in figure 5.

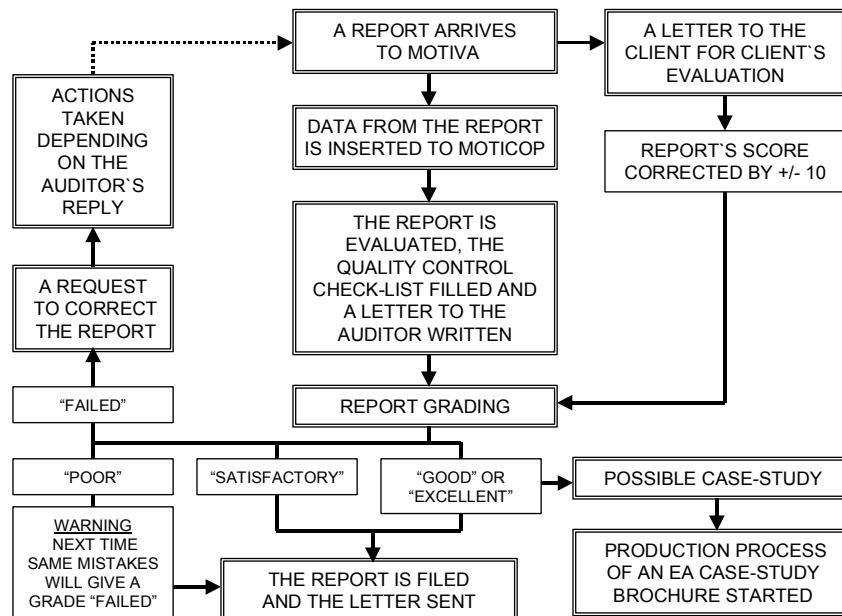


Figure 5 The Quality Control process in Finland's EAP

The quality control process concerns in principle all reported energy audits but if one completed project consists of numerous energy audit reports the quality control will pick only some of the reports for a detail check-up. In industry this is seldom the case and therefore these reports are in practice checked all.

The quality control concentrates on the following issues:

- The general guidelines have been followed
 - e.g. if a certain EA-model has been named in the application for the grant, the work is not allowed to be reported according to a lighter EA-model
 - several minimum requirements defined in the guidelines that concern all EA-models must be met - e.g. the measurements
 - all standardised parts of the report must be written as requested
 - certain tables and appendices must exist

- The EA-model specific guidelines have been followed
 - each EA-model has a standard Table of Content
 - several EA-models have a Best Practise Report (as an example how the reporting should be done) and EA-model specific instructions on how to do the actual work
- The presented numbers are realistic
 - the quality control personnel have a good understanding on how much a certain measure can really save in MWh/a and in percentage of the total consumption as well as what is a realistic level of investment
 - total saving potential is a net value and does not include overlapping or optional measures
 - key-numbers presented in separate chapters of the report and in standard tables (all defined in the guidelines) are in line
- The content of the report is technically correct
 - auditors sometimes take too big challenges and the skills and experience are not adequate for the work
- The proposed measures are relevant and realistic
 - the quality control has the competence to assume some type of measures to be found in a building of certain type and age, or look for a clear explanation if none of the most typical measures are presented
 - but also comment if the proposed measures are far too optimistic
- The report is “neat” in general

In order to standardise the quality control Motiva’s Energy Audit team has developed a standard check-list according to which the quality control is implemented and documented. Based on the quality control each report will be given a grade. The grade is defined by counting fatal, major and minor faults of a report. One fatal equals 60 points, which means that the report is worthless or totally against the guidelines. One major fault equals 5 points and one minor 2 points. The total score is subtracted from 100 points. Based on client’s evaluation this score is finally corrected by +/- 10 points.

The grading system includes grades:

- Excellent 91 to 100 points
- Good 76 to 90 points
- Satisfactory 61 to 75 points
- Poor 51 to 60 points
- Failed less than 50 points

“Failed” means that the auditor is requested to correct the report. The three main reasons why some reports are poor or failed are:

- Inadequate competence of the auditor
- Work done in a hurry – low budget and no time to do good work
- The scope of work has been totally different but in order to get the subsidy it has been made an EA “look-a-like” – normally without success

Auditors with reports with grades “good” and “excellent” are those, which Motiva recommends to clients in need for an auditor. All auditors will get a written evaluation of their work as well as the quality control check-list, where the comments and recommendations are given in detail. The grading system is being tested during year 2001 and put officially into force in 2002.

Developing the grading system was not a simple task. First to decide what is fatal what major and what minor fault and how many can be accepted. Also the sensitivity of the number of points to be subtracted because of these major or minor faults required quite a lot of testing before it became fair.

Lessons learned

The quality control is an essential part of an EAP. Without control the quality of energy audit reports will gradually decrease. The natural reason to this is the fact that there are always auditors who try to choose the easiest way to get the job done. The next step is that these auditors start beating down the prices and then finally everyone who wants to be in the business has to find a way to do the work lighter and lighter. Motiva had a resource problem in 1996-1997 and due to the neglected quality control the quality of the reports started to decrease slowly but clearly. A lot of work was needed in 1998 before the situation was corrected.

The best sanction for poor work is to hold back the subsidy payments as long as the quality of report is not satisfactory. The auditor is more eager to do proper work if there is even a small risk that he is not paid for it. If the client has paid the audit fee to the auditor, the Operating Agent can hold back the subsidy. In this case the client will be very dissatisfied with the auditor and will surely try to make the auditor to correct the report. Unfortunately this option can be unfair to the client if he has, in good faith, ordered the work but is neither able to make the auditor correct the report or request the paid fee to be returned.

In Finland the quality control takes place after the client has paid the auditor and the subsidy paid to the client. This is not a desired option but a decision made by the Administrator in 1994, which cannot be changed by Motiva. Therefore Motiva can only influence on the energy auditors and the authorisation is in principle the strongest weapon, which can be used. One idea of the new grading system is to give Motiva grounds for public diversification of the “good” and “not-so-good” auditors.

2.1.10 Monitoring

The EAP has an on-line monitoring system MOTICOP, which is an ACCESS application designed to file all relevant data concerning the energy audits. Today the MOTICOP is the most important part of the programme scheme. By the end of year 2000 the MOTICOP contained information on 4 466 individual audited buildings or sites and on over 19 500 energy saving measures.

The data on an individual energy audit is fed into the MOTICOP in three phases. The first phase of information on an energy audit is filed when a subsidy is granted by the EEDC or by the MTI's Energy Department. The EEDCs send regularly copies of all subsidy decisions to Motiva. The information includes some basic data on the applicant e.g. the total energy and water consumption and costs of the building to be audited. By this information Motiva can follow the penetration of energy auditing in different building and client sectors.

The second phase of information on an energy audit is filed when the audit report is submitted to Motiva via the EEDC. At this point the audit has been completed and the report includes information on actual energy and water consumption and costs and a list of all profitable energy saving measures with comprehensive numerical data. The data is presented in standard tables that are submitted also in digital format in order to simplify the filing of the data. This phase provides information on the average saving potentials in different sectors and in different types of buildings. Based on this information, it is also possible to list the most common saving measures and, if needed, even evaluate individual auditor's performance in comparison to others. This information is used also for promoting energy auditing by releasing information on the good case studies and the most significant saving possibilities.

The third phase of information on an individual energy audit is filed on those buildings that are chosen to be the target group for a follow-up questionnaire. Each building owner is obliged to submit information during a three-year period after the subsidy has been paid. The purpose of the questionnaire is to monitor the implementation rate of the suggested energy saving measures. The questionnaire is based on the list of measures proposed in the original energy audit report but includes also questions on the present energy and water consumption to get some impression on how the implementation has affected on them. In some cases the returned questionnaire has contained several other implemented measures in addition to the ones actually found and proposed by the auditor. These measures are not filed into the MOTICOP and bring therefore additional savings compared to the average statistical values. Motiva has carried out three follow-up questionnaires (1995, 1996 and 2000)

An operational monitoring system has been an essential tool to control a large-scale energy audit programme. Without the MOTICOP there would have been very little information available on the progress of the EAP or on the results achieved. The required outputs and available inputs for the monitoring system were carefully evaluated because an energy audit report contains a lot of data and it is necessary to decide what needs to be filed into the databank and what can be left to the file copy of the report. Radical changes to the structure of the monitoring system, as it has turned out clear with the MOTICOP, can be quite difficult to make.

The reliability of MOTICOP's data is crucial and all input data is checked to some extent. In principle there is also a possibility to scan out the false data by setting maximum and minimum values to various parameters, but even with automatic scanning the evaluation and the corrections have to be done manually.

The amount of work needed to maintain a monitoring system should not be underestimated. The needed resources depend naturally on the auditing volumes but also on how much time is spent to carry out analysis for various purposes and how actively this type of information service is marketed to various bodies like the media. The MOTICOP was in very active use in earlier years when the promotion of energy auditing was a top priority. A lot of sector specific information was continuously needed for the media, auditors and other interested bodies. The filing process itself (as well as the quality control) is actually a good spot to pick up the good examples for publishing purposes.

In principle if information is needed e.g. on small (5 000 to 10 000 m³) school building it will take only a few minutes to produce the following figures, typically needed in a presentation:

- Total figures of the sample
 - e.g. 75 schools, total building volume 120.000 m³, average...etc.
 - total consumption and cost: heat, electricity and water
 - total savings in MWh/a and in energy costs
 - total investments
 - and all kind of information (e.g. specific consumption kWh/m³,a) which can be calculated from this basic data
- Total figures on saving potentials
 - in percentages: heat, electricity and water
 - divided into groups by pay back times
- Typical energy saving measures of the building type in concern
 - all proposed measures divided into 33 classes (2-digit classification system)
 - by each class: number of measures (probability), average savings in energy and costs, investments and pay back times
- All information can be run geographically, based on ownership of the schools, age of schools, when audited, etc.
- By connecting this data to the follow-up questionnaires also information on implementation rates can be given, which will in practice give a good and realistic estimate on how much energy, in this building group
 - can be saved at the national level
 - how much that will cost and
 - what share of the total stock has been audited so far

For the last few years the MOTICOP has been used more as an internal tool in Motiva. One important milestone was the launch of Finland's VA Scheme. Energy audits play a key role in this scheme and therefore the MOTICOP is today tightly connected to the reporting and monitoring of this scheme. The VA Scheme has a separate monitoring system ESSU, which was developed during 1999-2000, but a lot of information is still processed by the MOTICOP. These two monitoring systems are run separately but parallel and data can be transferred between the systems when needed.

During the years 1996 and 1997 the EAP monitoring process had severe resource problems, which lead quickly to piles of non-filed and unchecked reports. This weakened rapidly the reliability of the monitoring itself and a lot of work was required before the on-line status and reliability was restored in the autumn of 1998.

2.1.11 Auditing volumes

The monitoring of energy audit volumes is based on annual subsidies, building volumes in the tertiary sector and energy usage in industrial sector. The total turnover has been approximately 24 million EUR during period 1992-2000. Previously, the building volume was used also in industrial sector but in 1998, when the process industry entered the EAP, the building volume became irrelevant.

The volumes during period 1992-2000 are shown in tables 1 to 3. During period 1992-1996 energy audits were implemented by the municipalities (Public), private services sector (Private) and in the industrial sector (Industry) by the non-process industry.

Table 1. Energy audit volumes in Finland during period 1992-1996

Year	Sector	Decisions	Number of buildings	Building volume, tertiary (Mm3)	Heat and fuels, industry (TWh/a)	Electricity, industry (TWh/a)	MTI's subsidy (MEUR)
1992	Public	13	63	2,2			0,17
1992	Private	20	95	5,2			0,25
1992	Industry	24	37		0,2	0,04	0,29
1992	Total	57	195	7,4	0,2	0,04	0,71
1993	Public	36	173	4,2			0,30
1993	Private	58	175	5,0			0,29
1993	Industry	64	131		1,4	0,8	0,89
1993	Total	158	479	9,2	1,4	0,8	1,50
1994	Public	102	719	12,3			0,91
1994	Private	159	295	10,7			0,61
1994	Industry	99	145		0,6	0,4	0,72
1994	Total	360	1159	23,1	0,6	0,4	2,22
1995	Public	83	569	7,4			0,52
1995	Private	93	169	6,9			0,35
1995	Industry	52	80		0,7	0,4	0,35
1995	Total	228	818	14,2	0,7	0,4	1,23
1996	Public	66	430	6,6			0,42
1996	Private	53	77	2,9			0,13
1996	Industry	45	78		0,5	0,3	0,37
1996	Total	164	585	9,6	0,5	0,3	0,94

The figures show the auditing volumes took a dive in 1995. The volume in 1997 was the lowest in the history of the EAP. The main reason to this development was the rapidly improved situation in the construction business in both tertiary and industrial sectors. Most of the auditors work in companies where the basic business is design projects. During the years 1992-1994 the building sector in Finland was in recession and the new area of energy auditing was very tempting to many consulting companies. At the same time the building owners had problems in finding or keeping tenants and were really interested in reducing their costs - energy being one of the possibilities. When the branch started to recover, the number of staff in the consulting companies had been adjusted to the low level of demand and in the beginning of year 1997 practically all capable engineering resources were allocated on design projects. The revival of the market has also decreased the building owners' interest on energy auditing.

The auditing volumes have shown to be strongly bound up with both the overall development of the building sector and the industrial production. If the clients' interest lies in other problems, there is very little to be done by an energy audit programme - if it is a stand-alone action. Therefore the continuity must be secured by other means. In Finland the most potential driver has been the VA Scheme.

Although the first agreements were signed in November 1997, the effect on granted subsidies was significant already during the following year. The annual energy use in the industrial sector was double compared to the cumulative use of the previous five-year period. In year 1998 some 50 to 75% of the total volume was launched by those enterprises and organisations within the VA Scheme and not previously active in energy auditing. In year 2000 the VA Scheme clients represented over 90 % of the total auditing volume.

In year 1997 also the energy sector (Energy) entered the EAP. This sector has not been very active but when the new EA-models are put into practice in 2001-2002 and hopefully good results can be presented, it is expected to increase significantly from today's level.

Table 2. Energy auditing volumes during period 1997-2000

Year	Sector	Decisions	Number of buildings	Building volume, Tertiary (Mm3)	Heat and fuels, industry (TWh/a)	Electricity, industry (TWh/a)	MTI's subsidy (MEUR)
1997	Public	32	191	2,6			0,17
1997	Private	61	91	3,3			0,17
1997	Industry	33	49		0,6	0,3	0,34
1997	Energy	1	1				0,03
1997	Total	127	332	5,9	0,6	0,3	0,71
1998	Public	26	206	2,5			0,24
1998	Private	27	27	0,9			0,05
1998	Industry	32	110		6,6	2,6	0,67
1998	Energy	2	2				0,13
1998	Total	87	345	3,4	6,6	2,6	1,09
1999	Public	15	147	2,1			0,27
1999	Private	15	20	0,7			0,03
1999	Industry	43	53		20,2	10,2	1,23
1999	Energy	7	13				0,08
1999	Total	80	233	2,8	20,2	10,2	1,61
2000	Public	16	195	4,2			0,39
2000	Private	19	55	2,8			0,15
2000	Industry	56	64		9,8	7,6	1,26
2000	Energy	4	6				0,05
2000	Total	95	320	7,1	9,8	7,6	1,85

Years 1998 and 1999 were still very quiet years in the public and private service sectors but both sectors improved in year 2000. In the private services sector the VA Scheme was signed in May 1999 and it will take some time before all the major building owners join the scheme and start taking action to fulfil their “auditing obligations”. In the public sector the municipalities were also quite slow to join the scheme during the first two years, but now the coverage has reached a satisfactory level. This will keep the annual auditing volumes in a good level at least until year 2005.

In the industrial sector the energy usage within the EAP has gone up to 53 % of the total electricity usage and to 36 % of the total heat and fuels of the Finnish industry. This significant penetration has taken place during the last 2 years and therefore the volumes in this sector cannot grow from the present level – without a significant increase in the total consumption, which is definitely not the desired direction.

Table 3. Total energy auditing volumes by sectors during period 1992-2000

Sector	Decisions	Number of buildings	Building volume, Tertiary (Mm3)	Heat and fuels, industry (TWh/a)	Electricity, industry (TWh/a)	MTI's Subsidy (MEUR)
Public	389	2 693	44,1			3,36
Private	505	1 004	38,4			2,07
Industry	448	747		40,7	22,7	6,14
Energy	14	22				0,30
Total	1 356	4 466	82,6	40,7	22,7	11,87

2.1.12 Results

The actual results of the EAP can be evaluated by the saving potentials reported in the energy audit reports and by the status of implementation reported by the clients. Data on actual measured savings is difficult to get in large samples and therefore Motiva has collected that type of information only from individual case studies. This information is collected mainly to provide material for the media, for Motiva's own seminar presentations and for Motiva's case-study brochures.

The degree of freedom to present the results by the monitoring system MOTICOP is very good. Each energy audit is filed with data on the building type and the branch sub-sector of the client. All proposed energy saving measures are defined by a two digit coding system.

By the end of year 2000 the estimated annual savings in energy and water costs of the audited buildings are 26,7 MEUR. Cumulative savings during period 1992-2000 are over 170 MEUR. In energy consumption the annual savings are approximately 1 TWh/a and cumulative savings 4,3 TWh.

Motiva has published an Annual Report on Energy Auditing since 1994. The edition, 1500...2500 copies is distributed to all auditors and several other groups interested or involved in the auditing business. The following results of the EAP are based on the Annual Report on Energy Auditing 2000.

Table 4. Energy saving potentials in the public service sector: 1 213 buildings, building volume 18,8 million m³, audited during 1995-2000

Consumption	Saving potentials		
Heat			
882 GWh	137 GWh	15,5 %	
23,8 MEUR	3,6 MEUR	15,0 %	
Electricity			
318 GWh	21 GWh	6,6 %	
19,2 MEUR	1,9 MEUR	10,0 %	
Water			
3 180 000 m ³	280 000 m ³	8,8 %	
6,2 MEUR	0,6 MEUR	9,2 %	
Total costs	Total savings		Total investment
49,2 MEUR	6,1 MEUR	12,3 %	10,8 MEUR

Table 5. Energy saving potentials in the private service sector: 293 buildings, building volume 13,2 million m³, audited during 1995-2000

Consumption	Saving potentials		
Heat			
412 GWh	79 GWh	19,2 %	
11,0 MEUR	2,0 MEUR	18,3 %	
Electricity			
404 GWh	26 GWh	6,4 %	
22,7 MEUR	1,9 MEUR	8,3 %	
Water			
1 478 000 m ³	123 000 m ³	8,3 %	
3,1 MEUR	0,3 MEUR	8,2 %	
Total costs	Total savings		Total investment
36,8 MEUR	4,2 MEUR	11,3 %	8,4 MEUR

Table 6. Energy saving potentials in the industrial sector: sites with energy usage less than 10 GWh/a, 175 sites, audited during 1995-2000

Consumption	Saving potentials		
Heat			
224 GWh	59 GWh	26,3 %	
5,3 MEUR	1,4 MEUR	26,1 %	
Electricity			
185 GWh	15 GWh	8,2 %	
9,5 MEUR	1,0 MEUR	10,6 %	
Water			
1 538 000 m ³	203 000 m ³	13,2 %	
1,9 MEUR	0,3 MEUR	12,7 %	
Total costs	Total savings		Total investment
16,7 MEUR	2,7 MEUR	15,7 %	5,6 MEUR

Table 7. Energy saving potentials in the industrial sector: sites with energy usage between 10 and 70 GWh/a, 46 sites, audited during 1995-2000

Consumptions and costs	Saving potentials		
Heat 510 GWh 10,4 MEUR	122 GWh 2,5 MEUR	23,9 % 23,9 %	
Electricity 519 GWh 20,5 MEUR	39 GWh 1,7 MEUR	7,6 % 8,5 %	
Water 6 525 000 m3 4,9 MEUR	609 000 m3 0,6 MEUR	9,3 % 12,9 %	
Total costs	Total savings		Total investment
35,9 MEUR	4,9 MEUR	13,6 %	10,5 MEUR

In the autumn of year 2000 Motiva sent a questionnaire to 1077 audit clients to update the implementation rates of proposed energy saving measures. Returned questionnaire sheets of 498 buildings were analysed. Each energy saving measure, originally proposed in the energy audit report, had one of the following statuses: Implemented, Decided, Considered, Not to be implemented. The results of the questionnaires are shown in tables 8 to 10.

Table 8. Realisation of the energy saving potentials in the public services sector: 310 buildings, 1 781 energy saving measures

Public	Heat		Electricity		Water		Costs	
Status	GWh	%	GWh	%	km3	%	MEUR	%
Implemented	21,1	60,5	3,0	58,3	24,2	52,5	1,04	60,7
Decided	3,3	9,5	0,7	12,7	2,4	5,3	0,16	9,7
Considered	4,2	12,0	0,7	13,9	7,3	15,8	0,22	13,0
Rejected	4,0	11,4	0,4	7,9	7,0	15,1	0,17	9,7
Not informed	2,3	6,5	0,4	7,2	5,2	11,3	0,12	6,9
Total	35	100	5	100	46	100	1,71	100

Table 9. Realisation of the energy saving potentials in the private services sector: 115 buildings, 893 energy saving measures

Private	Heat		Electricity		Water		Costs	
Status	GWh	%	GWh	%	km3	%	MEUR	%
Implemented	17,5	54,9	5,0	53,2	20,8	55,0	0,89	54,4
Decided	1,7	5,3	0,1	1,6	4,8	12,8	0,07	4,3
Considered	3,6	11,4	1,4	14,6	4,0	10,6	0,19	11,9
Rejected	5,4	16,9	1,6	17,2	5,6	14,8	0,29	17,9
Not informed	3,7	11,6	1,3	13,6	2,5	6,7	0,19	11,6
Total	32	100	9	100	38	100	1,64	100

Table 10. Realisation of the energy saving potentials in the industrial sector: 68 sites, 686 energy saving measures

Industry	Heat		Electricity		Water		Costs	
Status	GWh	%	GWh	%	km3	%	MEUR	%
Implemented	41,0	38,1	12,0	55,5	102,4	30,6	1,45	40,4
Decided	13,1	12,2	2,9	13,3	4,2	1,2	0,38	10,6
Considered	22,8	21,2	2,9	13,6	137,4	41,1	0,69	19,3
Rejected	27,2	25,3	2,4	11,0	88,2	26,4	0,93	25,9
Not informed	3,4	3,2	1,4	6,7	2,1	0,6	0,13	3,8
Total	108	100	22	100	38	100	3,58	100

When estimating the total effect of energy auditing all energy saving measures with status Implemented and Decided are taken into account and one third of those with status Considered. Compared to the previous questionnaire in 1996 the realisation of proposed energy saving measures is at a satisfactory level. The results are shown in the following table.

Table 11. Realisation rates of proposed energy saving measures in questionnaires in 1996 and 2000.

Total rate of realisation	1996	2000
Heat	74 %	62 %
Electricity	62 %	70 %
Water	64 %	50 %
Costs	67 %	63 %

The questionnaire also showed that the realisation rate is good when the pay back time is less than 2 years but is significantly reduced when the pay back time is longer. The number of proposed energy saving measures is also declining in line with the increasing pay back time. The correlation between the pay back time (Y) and number of proposed measures (N) is shown in the following table.

Table 12. Correlation between number of proposed measures and pay back time of the investment

P	0	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10+
Y	3167	2618	1533	1054	734	526	414	350	238	270	312	18

The guidelines for energy auditing require the auditors to look in principle for all energy saving measures with a pay back time less than 10 years. Based on the declining number of measures and the decrease in the realisation rate of measures with longer pay back time, one cannot avoid the conception of auditors more or less ignoring those measures which they know or presume that the clients are not interested in.

The reasons why energy saving measures are not implemented are divided into five categories:

- Profitability
- Financing
- Non-valid proposal
- Other reasons
- No explanation given

Profitability is purely a financial matter. In municipalities pay back times up to 4...5 years are considered satisfactory but e.g. in industry the company policies can be very tight and limit implementation to investments with pay back times less than 2 years.

Financing can be divided into two sub-categories: a) there is absolutely no money available or b) the energy saving investments cannot compete with other investments within a fixed investment budget.

There are always some *Non-valid* proposals, some due to technically false solutions, some due to increased risk e.g. to stability of a process or to some other kind of "quality factor" of output or provided service. But also individual client's personal opinion can put proposals to *Non-valid* category even if they are technically sound and financially profitable.

Depending on the sector and the type of proposed measure the rate of energy saving measures, which have status "*Not to be implemented*", varies between 5 and 25 % of the total saving potential. In order to be able to present the shares of different reasons why the clients do not implement measures we assume that in general 20 % of the total saving potential of all measures have a status "not to be implemented".

Profitability is given as a reason in 15 to 22 % of this one fifth, industrial sector representing the highest value. *Financing* is given as a reason in 7 to 17 %, industrial sector being the lowest and private services the highest. This gives an indication that in industry capital is not a problem if the measure otherwise is sound. *Non-valid* measures are the most common reason with 44 % in public service sector, 28 % in private service and 40 % in industrial sector. *Some other reasons* represent approx. 20 % in all sectors and a share of 10 to 20 % was without any comment.

Generalised, if we take 10 proposed measures on which the clients have given the status “rejected”, the main reasons are following:

- 4 non-valid proposal
- 1½ profitability
- 1 financing
- 2 some “other reason” than the 3 above
- 1½ no clear reason given

One common explanation connected to category *Other reasons* was a scheduled larger scale renovation coming up in the near future – totally acceptable.

2.1.13 Evaluation

Finland’s EAP has been evaluated a few times by national and international experts and the feedback has very been positive. The fact that the EAP is one of the longest MTI’s programmes ever, is maybe the best proof that the EAP has met the targets and has provided the MTI the expected results.

Motiva has carried out a programme level evaluation each year since 1995. The Annual Report on Energy Auditing, published by Motiva, includes all relevant information on the annual and cumulative results. The annual evaluation provides information on the annual saving in heat, electricity and water as well as energy and water costs. Cumulative savings have been calculated by taking into account only the last six years and therefore the period 1992-1994 is not included in the evaluation of year 2001. This is just a taken approach by which Motiva tries to take into account that e.g. the lifecycle of energy saving measures in practice varies between maybe 3...15 years.

In the evaluation there are four different energy auditing volumes which need to be taken into account. The smallest sample is the follow-up questionnaire, which provides information on the actual realisation rates. Next sample is the submitted and statistically comprehensive EA reports from the period 1995-2000. This sample provides the trustworthiest energy saving potentials in each sector. In addition this sample there is a group of submitted EA reports from the same period, which for several reasons, have been excluded from the statistical analysis - e.g. the cost for water has not been reported, which does not mean that report could not be excellent.

Furthermore, the largest known sample or building volume is naturally all those audits, which have been granted during period 1995-2000. Quite a lot of these audits have been completed although not yet submitted to Motiva. In the calculation of the total effect of energy auditing, it is assumed that 50% of the gap between the granted and reported audits (in building volume) have been completed and measures implemented according to the realisation rates provided by the follow-up questionnaire.

2.1.14 Observations and Future Plans

Finland's EAP has been running since 1994 and based on self evaluation, is a comprehensive programme level activity which has fulfilled the given goals - as far as it has been in Motiva's hands. Theoretically the EAP has all the necessary elements in place. Some of the options are not really the best practices today but there are several historical and legislative reasons why all elements cannot be optimally tuned.

Operating an EAP is not a continuously glamorous job. An EAP has several routines that just have to be taken care of. In some areas the minimum amount of work is relatively high and the nature of the work unfortunately means that you either do it – or you don't do it at all.

One concrete question is the quality control; does it benefit to put a lot of resources to marketing of the audits if the quality of the work is poor due to non-existing quality control. How long is the lifecycle of a poor product? If e.g. 10 % of the audits in Finland would be poor, it would mean that some 200.000 EUR of subsidies per year would be totally wasted, as well as another 200.000 EUR of the clients' money. And this 10 % is just a modest guess on the share of "zero-reports" if quality control would not exist. In respect to the level of wasted money, the cost for a good quality control would be 30...40.000 EUR per year. This would not just reduce the amount of really poor reports but increase the quality of all reports.

A good estimate is that 1 EUR put into the quality control will bring back 10 EUR in subsidies with another 10 EUR of the clients' money is put to a better use. Furthermore a reduction of 1 % in the found energy saving potential could decrease the annually realised savings by 3 MEUR/a. A good point for the Administrator to remember when allocating resources for the Operating Agent.

The main area to be developed in the future is the integration of renewables into the EAP. Today the energy auditors analyse only energy saving opportunities and propose only energy saving measures. When the scope has changed from pure energy saving to the reduction of greenhouse gas emissions, also the EAP must try to take this into account. The energy auditors have annually hundreds of contacts to clients and this resource should be taken into use also in the aspect of reducing GHGs.

The lifecycle of Finland's EAP has been exceptionally long and the termination day is not yet in sight. Due to the Voluntary Agreement Scheme also the EAP will have to be run at least until 2005.

3. Other Programmes including Energy Audits

3.1 The Voluntary Agreement on Energy Conservation

The Ministry of Trade and Industry and four branch organisations concluded a voluntary Agreement on the Promotion of Energy Conservation on November 10th, 1997. By autumn 2001 a total of nine agreements have been put into force along with one branch co-operation agreement with equal aims.

The aim of the Voluntary Agreement Scheme is to reduce the specific energy consumption and to develop and introduce methods, which would allow energy efficiency to be integrated into everyday operations. Crucial measures according to the agreement are energy auditing and the implementation of the measures found in the audits. The Ministry finances the activities within the limits of appropriations made. One essential part of the contractual system is the monitoring of results.

A company that enters the energy conservation agreement agrees to carry out the measures laid down in it. But the timing of the measures depends on the time schedule to be set by the company itself. Each participant has to appoint a person to be in responsible for energy conservation within his organisation and take into account energy efficiency in investment decisions. For the monitoring of the agreement the company must also annually give details of its energy usage and the various factors that have affected it.

Annual Reports on each sector agreement are compiled yearly by Motiva in co-operation with the associations to provide all parties within the system feedback on their own situation and on the situation of the entire sector. The first Annual Reports were compiled in year 2000.

The content and the structure of an agreement vary slightly depending on the sector. E.g. in industry when joining the agreement, a company is required to name the date by which it intends to draw up a detail report on its energy use situation. This must indicate the products made by the company and how much electricity, heat/fuels and water has been consumed each year and what the energy costs have been. The report must include the contact details for the persons in charge of energy conservation measures in the company and a schedule for the energy audits. Besides providing information needed to monitor the agreements, this report is intended to serve as an instrument permitting the company to begin the planning of audit activities.

In the light of the energy audits, the company sets for itself energy efficiency targets and draws up a plan for measures needed to achieve them. Every organisation within the agreement is obligated, but also allowed, to carry out its conservation measures in terms of its own resources and time schedule. As for investments all economically profitable projects should be carried out – but the companies can judge what is the limit for profitability.

3.1.1 Goals

The goals of the VA Scheme are in line with the national goals on GHG reduction and energy conservation, although the scheme itself does not have an officially defined share of the national goals. This is partly due to several overlapping activities e.g. energy auditing running as a separate programme but also as a part of the VA Scheme. The volume goals for the VA Scheme have been defined as coverage, either from the total sector volume or from the volume represented by the branch association. These goals are presented in the following chapter.

3.1.2 Target sectors

The target sectors of the Voluntary Agreement Scheme are in principle all energy users and suppliers. By October 2001 the goals and coverage of the signed agreements were the following:

Table 13. The target sectors and coverage of Finland's Voluntary Agreement Scheme on Energy Conservation

Sector (year when VA started)	Number of contracts	Coverage	Goal	Coverage calculated from
Industry (1997)	106	85 %	80 %	Total energy usage of Finnish industry
Municipalities (1997)	50	54	50 %	Total building stock (m3)
Real property & construction sector (1999)	16	67	50	The building stock represented by the association (RAKLI)
Power generation (1997)	23	90	80	Total production
Electricity transmission and distribution (1997)	46	77	60	Total distribution
District heating (1997)	40	70	60	Total energy sales
Transport/trucking (1999)	375	8	30	Total number of trucks owned by members of the association
Transport/buses (2001)	9	18	20	Total number of buses owned by members of the association
Oil sector (1997)				No coverage defined

In addition to these agreements the government owned building stock is also included via a separate co-operation agreement. The Ministry of the Environment is developing a similar voluntary agreement with the Housing Estate and Developer Federation, which will cover a major share of apartment buildings in Finland. This new agreement will be put into force in 2002.

3.1.3 Administration

The administration of the VA Scheme has been divided between the MTI, Motiva and the branch associations. In each agreement the responsibilities have been divided in a different way, but in practice Motiva is the Operating Agent for the scheme and is responsible for the total monitoring and reporting to the MTI.

The basic arrangement is that each association is responsible for contacts to individual companies or organisations, but because Motiva's basic task is to promote energy efficiency in these sectors, this arrangement concerns only certain formal tasks, which are necessary to run the scheme.

3.1.4 Implementing Instruments

The implementing instruments for the Voluntary Agreement Scheme are:

- Subsidies for energy audits
 - 50 % during period 1997 – 2001
 - 40 % in 2002, except for the municipalities which still get 50 %
- Subsidies for investments
 - 10 % during period 1997-2001
 - 15% in year 2002
- Financing for projects which aim at improvements in energy efficiency in the target sectors, partly directly to branch associations partly via Motiva
- Active marketing by the Operating Agent and the branch associations
- But maybe the best implementing instrument is the common understanding that if the VA Scheme does not work, the government may look for other instruments - which are not voluntary

3.1.5 Audit Models

Not specified in the scheme. For energy audits, see 2.1.5.

3.1.6 Auditors' Tools

None. For energy audits, see 2.1.6.

3.1.7 Training, authorisation and quality control

Training on energy efficiency issues is one part of the scheme. The MTI is subsidising some training courses, but training of their own personnel is also one obligation for the organisations within the scheme.

3.1.8 Monitoring

Motiva is responsible for monitoring the VA Scheme. The monitoring system ESSU was planned 1998, built in 1999 and used for the first time in the autumn of 2000 when the first Annual Reports on VAs were published. The development work on the ESSU has been continuing also through years 2000 and 2001 due to new sector agreements, but also due to some necessary modifications.

The reporting is in principle as accurate as it can be, without creating totally new on-site data capture system. The planning of the reporting system was a process, which took several months but has now shown to be worth it. The basic options were “rough” and “accurate” but based on the significantly better outputs, the “accurate” was a finally a clear choice. The principles were planned in Motiva but all details have been negotiated with the branch associations and comments have been asked from the companies too.

The ESSU is located in Motiva but the branch organisations have their own “run-time” versions. Motiva will each year run the basic data from ESSU for the branch organisations, which are then responsible for sending it to the companies and organisations within the agreement. The base data will be up-dated and returned to the branch organisation where the data is verified and analysed. The branch organisations send the data to Motiva where the ESSU then updated.

3.1.9 Volumes

See chapter 3.1.2 Target sectors.

3.1.10 Results

The most comprehensive results are available from the industrial agreement. Based on the Annual Report 2000 on Industrial Voluntary Agreement, the companies have implemented 147 energy saving measures in 2000. The total effect of these measures is a reduction of 0,48 TWh/a in heat and fuels and 0,28 TWh/a in electricity. The required total investment has been 23 MEUR. The cumulative saving, since the beginning of the VA Scheme, is 1,6 TWh/a in heat and fuels and 0,35 TWh/a in electricity.

The realistic saving potential of those companies within the VA Scheme that have so far completed energy audits, is 4,14 TWh/a in heat and fuels and 1,22 TWh/a in electricity. These figures are based on 2 637 reported energy saving measures – several companies are still in the process of launching or implementing the energy audits.

More comprehensive and detail information on the results of Finland’s VA Scheme is presented in the Annual Reports of each agreement sector.

3.1.11 Evaluation

The Voluntary Agreement Scheme is being evaluated sector by sector during 2001-2002 by an Evaluation Team. The evaluation work has been ordered by the MTI and the aim of it is to see whether the agreements are providing expected results and if some agreements should be modified – if and when the next period of the schemes are being negotiated between the MTI and the branch associations.

3.1.12 Observations and Future Plans

One clear comment on the output of the VA Scheme is that it has been crucial from the EAP’s point of view. Without the VA Scheme the auditing volumes could have gone to such a low level that the point of maintaining any kind of administration for the EAP could have been questioned. When the idea of VAs was put on the table for

the first time in 1996, the importance and potential of it became clear – and although all sectors have not been equal success stories, the scheme itself is one of the best approaches ever.

All ongoing agreements will be terminated between years 2002 and 2005 and therefore the continuity and possible modifications are being studied. From Motiva's viewpoint it is difficult to see other options, which would provide equally wide coverage and equally effective tools. Still, it is too early to say how significant results the VA Scheme will bring, because some of the agreements have just started and the first agreement are just starting to provide adequate information.

3.2 Condition Assessments in residential sector buildings

The Condition Assessment Scheme is one part of a wider scheme, which aims at improving the condition and maintenance of residential sector buildings. Condition Assessment is the first step, which can be followed by studies on specific areas. The next step, the detail studies, has been subsidised since 1999. The subsidy is 1,3 EUR per m², but max. 30 % of the total cost. Pre-condition to get this subsidy is a Condition Assessment. Furthermore a Maintenance Book, which is in Finland mandatory for all new residential buildings, which receive grants from the government, is promoted in the existing building stock by subsidising it by 0,5 EUR per square metre. Pre-condition for this subsidy is equally a Condition Assessment: if a CA has not been implemented already, it must be included as one part into the process of implementing the Maintenance Book.

3.2.1 Goals

The Ministry of the Environment has supported condition assessments in the residential sector buildings since 1993. The aim of the programme is to promote methodical renovation based on a long-term plan on maintenance and repairs and to prepare the building owners for future investments.

3.2.2 Target sectors

The target sector of the Condition Assessment is block of flats and terrace houses.

3.2.3 Administration

The Administrator of the Condition Assessment Programme is the Finnish Housing Board, which is part of Finland's Environmental Administration. Local municipal housing authorities act as Operating Agents and are responsible for handling the subsidy applications and payments as well as for the quality of the assessment work.

The subsidies for the condition assessment are applied and granted in the spring. Building owners send the applications to their municipal housing authority, which then applies for the total amount from the Housing Board as a lump sum. Depending on the total amount of applied subsidies and the available annual budget, the Housing Board will then divide the total budget between the local authorities, to be further divided between their applicants. First version of guidelines for the condition assessments in block of flats and row houses was published in 1993. Both guidelines include an energy audit module.

3.2.4 Implementing Instruments

The programme is totally voluntary but subsidised by 0,5 EUR per m², the maximum subsidy being 50% of the total cost.

3.2.5 Condition Assessment Models

Building Information Ltd publishes a wide range of material concerning all aspects of construction and management of buildings. One type of the published products is a set of files on specific issues. In one of these files the Building Information Ltd has published guidelines on Condition Assessment in residential sector buildings. This file includes e.g. the following booklets:

- Instructions on how to order a Condition Assessment
- A model report for a Condition Assessment in a residential sector building
- Several booklets on condition assessments in specific systems
- Instruction on the implementation of a Condition Assessment
- Instruction on the implementation of an energy audit as a part of a Condition Assessment

In addition to these documents the Ministry of the Environment has published several reports to standardise the condition assessment procedures and methods in specific areas.

3.2.6 Tools

The tools for the condition assessment experts include

- Working instructions
- Model report
- Checklists
- Tender examples

3.2.7 Training, authorisation and quality control

The Condition Assessment Programme does not require authorised experts to be used but is recommended that the building owners should use experts with a Certificate in Appraisal.

Private training organisations arrange Condition Assessment Courses. The 70-hour training course consists both administrative and technical issues. The course includes also practical fieldwork in an existing building. After the CA Course the candidates can apply for the one-day exam. Requirements in addition to the CA Course are:

- Suitable basic education
- Minimum of 10 years working experience in the field

By the end of year 2001 some 250 experts have passed the exam on condition assessment. The list of the certified experts is public and available for all building owners.

3.2.8 Monitoring

The Condition Assessment Programme has no separate monitoring system. The annual volumes, based on granted subsidies and assessed buildings, are monitored by the Housing Board. The quality of the assessments is controlled to some extent by the local municipal authorities granting the subsidies.

3.2.9 Condition Assessment Volumes

The Ministry of the Environment has supported condition assessments in residential sector buildings since 1993. By the end of year 1995 the condition assessment programme had covered some 5000 to 5 500 buildings, mainly block of flats. The annual volumes since 1995 are shown in table 14.

Table 14. Annual volumes of condition assessments during period 1996-2000

Year	Number of buildings	Annual subsidy MEUR
1996	1 073	1,00
1997	1 106	0,98
1998	602	0,60
1999	738	0,72
2000	1 193	0,92
Total	4 712	4,22

3.2.10 Results

No information is collected about implemented energy saving or other measures.

3.2.11 Observations and Future Plans

In 1996 a study was carried out to monitor the quality of the condition assessments. The study revealed that the energy audit module was missing in half of the assessments. Some actions, like the abovementioned training programme for condition assessment experts and the certification scheme, have been taken in order to improve the quality of the assessments. Since there is no monitoring system, the quality and coverage of the implementation is not well known.

4. Other Activities including Energy Audits

Other activities including or promoting energy audits in Finland are the environmental management systems, condition assessments in the tertiary sector. The non-official system-specific EA-model, the Air Audit, is also presented in this chapter.

4.1 The Environmental Management Systems

The Environmental Management Systems (EMS) have continuously been an area where Motiva has made efforts to influence the decision makers to adapt good practises on energy issues – in practice to adapt energy audits. During year 1998 the first industrial sub-sector, the concrete manufacturing industry, adopted Motiva Model Energy Audits as an integral part of their guidelines on establishment of EMS.

4.2 Condition assessments in tertiary sector buildings

The condition assessments in the tertiary sector are very popular among the Finnish building owners. Many of the energy auditor companies offer condition assessment services as separate services but also in connection to energy audits. Due to the natural demand by the market place the Condition Assessments were more popular among the auditors during period of 1995-1997 - marketing of the energy audits was a costly necessity before the VA Scheme was introduced.

In order to benefit from this trend the MTI and Motiva co-operated with the Ministry of the Environment to develop *Guidelines for Condition Assessment in Tertiary Buildings*. The guidelines, published in 1998, contain information on how to combine an energy audit and a condition assessment in order to achieve the benefits of simultaneous work. The condition assessments in the tertiary sector, opposite to the residential sector, are not subsidised and therefore there are financial incentives to implement a condition assessment simultaneously with a subsidised energy audit.

4.3 The Air Audit

The Air Audit is a system-specific energy audit for compressed air systems. The Air Audit is a four-step service package, the steps being 1) installation of the measurement devices, 2) a 24-hour or a 7-day measurement period, 3) analysis of the results and compilation of the Air Audit report and 4) presentation of the results. The Air Audit studies both energy and functional aspects of a compressed air system. By the end of year 2001 over 450 Air Audits had been carried out in Finland and approx. 200 in other countries, mainly in UK, USA, Sweden and Norway.

The target group for the Air Audit are in principle all industrial facilities with compressed air systems. The interest of the supplier is, for clear reasons, in large multi-compressor systems. The Air Audit itself is recommended to system of sizes 80 to 100 kW and above. The pay back time of the audit varies from a few days to six months. Also smaller systems can and have been audited but the expected pay back time will be longer.

The cost of an Air Audit varies between 3 500 and 10 000 EUR and the average saving potential has been 15 to 20%. In old or poorly functioning systems the saving potential can go up to 30...40%.

One recommendation often given in the Air Audit report is Sarlin Balance, a compressed air system control solution, which has won the European Better Environment Award for Industry EBEAFI '98. The measured energy savings by the Sarlin Balance have been 10 to 30% and the guaranteed pay back times for the investment around one year.

The operating agent for the Air Audit is Sarlin Hydor in the Nordic countries and CompAir in world-wide.